

CLAIMS

Sub B1

1. A method for backing up a computer-readable object stored on a first logical device unit, the method comprising:

when the object is not currently mirrored to a mass storage device, creating a mirror for the object on a second logical device unit on a mass storage device;

when the object and the mirror for the object are split, resyncing the object with the mirror for the object;

splitting the object and the mirror for the object so that the mirror becomes a backup copy of the object and so that I/O requests directed to the object are not automatically directed to the mirror;

retrieving a current timestamp from the second logical device and saving it as a saved timestamp;

updating the timestamp upon executing any I/O operation directed to the second logical device that alters data stored on the second logical device;

when the object is determined to need to be restored from the mirror,

retrieving a current timestamp from the second logical device;

comparing the retrieved current timestamp to the saved timestamp;

when the current timestamp is equal to the saved timestamp, copying the mirror to the first logical device to replace or again create the object on the first logical device.

2. The method of claim 1 further including copying the object to a second backup copy on a difficult-to-modify mass storage device after splitting the object and the mirror for the object.

3. The method of claim 2 further including, when the current timestamp is not equal to the saved timestamp, copying the second backup copy from the difficult-to-modify mass storage device to the first logical device to replace or again create the object on the first logical device.

4. The method of claim 3 wherein the mass storage device is one or more hard disk drives and the difficult-to-modify mass storage device is a tape drive.

5. The method of claim 3 wherein the first and second logical units are provided by one or more disk array controllers, wherein data stored to the first and second logical units are stored by the one or more disk array controllers on one or more hard disk drives, and wherein the one or more disk array controllers provide timestamps to requesting applications and systems and update the timestamp associated with a logical device upon executing I/O operations directed to the logical device that alters data stored on the logical device.

6. The method of claim 1 further including, prior to retrieving a current timestamp from the second logical device and saving it as a saved timestamp, enabling timestamping on the second logical device unit, and wherein the timestamp is updated upon executing any I/O operation directed to the second logical device that alters data stored on the second logical device only when timestamping is enabled on the second logical device unit.

7. A method for backing up a computer-readable object stored on a first logical device unit, the method comprising:

when the object is not currently mirrored to a mass storage device, creating a mirror for the object on a second logical device unit on a mass storage device;

when the object and the mirror for the object are split, resyncing the object with the mirror for the object;

splitting the object and the mirror for the object so that the mirror becomes a backup copy of the object and so that I/O requests directed to the object are not automatically directed to the mirror;

retrieving a current count from the second logical device and saving it as a saved count;

incrementing the count executing any I/O operation directed to the second logical device that alters data stored on the second logical device;

when the object is determined to need to be restored from the mirror,

retrieving a current count from the second logical device;

comparing the retrieved current count to the saved count;

when the current count is equal to the saved count, copying the mirror to the first logical device to replace or again create the object on the first logical device.

LOGICAL DEVICE

8. The method of claim 7 further including copying the object to a second backup copy on a difficult-to-modify mass storage device after splitting the object and the mirror for the object.
9. The method of claim 8 further including, when the current count is not equal to the saved count, copying the second backup copy from the difficult-to-modify mass storage device to the first logical device to replace or again create the object on the first logical device.
10. The method of claim 9 wherein the mass storage device is one or more hard disk drives and the difficult-to-modify mass storage device is a tape drive.
11. The method of claim 9 wherein the first and second logical units are provided by one or more disk array controllers, wherein data stored to the first and second logical units are stored by the one or more disk array controllers on one or more hard disk drives, and wherein the one or more disk array controllers provide counts to requesting applications and systems and increment the count associated with a logical device upon executing I/O operations directed to the logical device that alters data stored on the logical device.
12. The method of claim 7 further including, prior to retrieving a current count from the second logical device and saving it as a saved count, enabling counting on the second logical device unit, and wherein the count is updated upon executing any I/O operation directed to the second logical device that alters data stored on the second logical device only when counting is enabled on the second logical device unit.

- Sub A1*
13. A mass storage device that provides logical device units to accessing computers, the mass storage device comprising:
- a medium for storing data;
 - data writing and reading devices for writing data to the medium and reading data from the medium;
 - memory and logic processing components; and

a controller that executes within a logic processing component and controls reading and writing of data to and from the memory and to and from the medium, the controller providing, in addition to execution I/O operations, including of read and write operations, to and from logical device units comprising portions of the medium for storing data, mirroring of an object stored on a first logical device unit to a mirror object stored on a second logical device unit and a current state metric for each logical device unit that can be requested by an accessing computer.

14. The mass storage device of claim 13 wherein the controller updates the current state metric for a logical device unit whenever the controller executes an I/O operation that changes the data, stored on the medium for storing data, included in the logical device unit's data.
 15. The mass storage device of claim 14 wherein the controller further provides I/O operations directed to a logical device unit that enables maintenance of a current state metric for the logical device unit and disables maintenance of a current state metric for the logical device unit, and wherein the controller updates the current state metric only when maintenance of a current state metric for the logical device unit is enabled.
 16. The mass storage device of claim 13 wherein the current state metric is a timestamp.
 17. The mass storage device of claim 16 wherein the controller updates the timestamp by saving a current time.
 18. The mass storage device of claim 13 wherein the current state metric is a counter.
 19. The mass storage device of claim 16 wherein the controller updates the counter by incrementing the counter.